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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/887,791	06/22/2001	Michael R. Sievers	FIS920000409US1	7660

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Philmore H. Colburn II
Cantor Colburn LLP
55 Griffin Road South
Bloomfield, CT 06002

EXAMINER

AHMED, SHAMIM

ART UNIT

PAPER NUMBER

1765

DATE MAILED: 12/12/2002

4

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/887,791

Applicant(s)

SIEVERS ET AL.

Examiner

Shamim Ahmed

Art Unit

1765

PL4

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 22 June 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-12 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-3, 5-10 and 12 is/are rejected.
- 7) ☒ Claim(s) 4 and 11 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 20 September 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 3.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter, which the applicant regards as his invention.

2. Claim 5 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

3. Regarding claim 5, the phrase "the beam current" renders the claim indefinite because it is unclear whether the current is for the focused ion beam or for the electron beam.

In the following rejections, regarding the claim 5, examiner interprets the "beam" as the focused ion beam.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1-3 are rejected under 35 U.S.C. 103(a) as being unpatentable over Allen et al (5,736,002) in view of Kuo (US 2002/0072228).

As to claim 1, Allen et al disclose a process for removing copper, wherein the copper surface or layer is exposed by patterning through a masking layer (col.3, lines 32-35).

Allen et al also disclose that the exposed copper is reacted with a halogen gas in order to produce a reaction product of copper and the halogen gas (col.3, lines 36-42 and col.6, lines 6-13, lines 34-40).

Allen et al teach that before removing the reaction product, the unwanted halogen gas is removed from the surface (col.10, lines 3-10).

Allen et al also teach that the reaction product is selectively removed from the copper surface by thermal vaporization (col.6, lines 39-43).

Allen et al remain silent about the introduction of focused ion beam is applied to remove the reaction products from the surface.

However, in a method of forming a pattern in a conductive layer such as copper, Kuo teaches that reaction product of halogen and copper is removed by thermal vaporization or by directing or focusing ion beam that will evaporate the reaction product (see paragraph 22 at page 2).

Therefore, it would have been obvious to one skilled in the art at the time of claimed invention to employ Kuo's teaching into Allen et al's method because both the thermal vaporization and the focused ion beam process are functionally equivalent for efficiently removing the reaction product as taught by Kuo.

As to claims 2-3, Allen et al teach that the halogen gas is selected from the group consisting of chlorine, fluorine, iodine or a mixture thereof (col.6, lines 46-49).

6. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Allen et al (5,736,002) in view of Kuo (US 2002/0072228) as applied to claims 1-3 above, and further in view of Li et al (6,194,720).

Modified Allen et al discussed above in the paragraph 5 but do not teach the ion beam having a current energy in the range of about 500 to 3000 pico Amps.

However, in a milling process using focused ion beam, Li et al teach that the beam current comprises an energy from about 2500-3000 pico Amps for providing a higher intensity of ion beams which are capable of removing more material in a shorter time period (col.7, lines 10-20).

Therefore, it would have been obvious to one skilled in the art at the time of claimed invention to combine Li et al's teaching into modified Allen et al's process in order to efficiently removing the reaction product by reducing the process time as taught by Li et al.

7. Claims 6 -10 rejected under 35 U.S.C. 103(a) as being unpatentable over Allen et al (5,736,002) in view of Kuo (US 2002/0072228) as applied to claims 1-3 above, and further in view of Chandler (6,211,527).

Modified Allen et al discussed above in the paragraph 5 and also teach that the copper surface is exposed through an insulation layer by using an appropriate photolithographic or other technique (col.5, lines 46-59).

Modified Allen et al fail to teach that the insulation layer is patterned by directing a focused ion beam.

However, in a method of using a focused ion beam to selectively etch dielectric layer in the fabrication of integrated circuits, Chandler teaches that a focused ion beam milling a hole or via with a high aspect ratio through the insulating layer above a conductor to expose the underlying conductor (col.2, lines 18-33 and lines 42-44).

Therefore, it would have been obvious to one skilled in the art at the time of claimed invention to combine Chandler's teaching into modified Allen et al's process in order to efficiently remove the insulation layer to expose the conductor layer as taught by Chandler.

As to claims 7 and 9, Allen et al teach that the halogen gas is selected from the group consisting of chlorine, fluorine, iodine or a mixture thereof (col.6, lines 46-49).

As to claim 8, Chandler teaches that the noble gas halide comprises XeF_2 (col.2, lines 42-43).

As to claim 10, Chandler teaches that the focused ion beam comprises gallium ions (col.3, lines 65-67).

8. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Allen et al (5,736,002) in view of Kuo (US 2002/0072228) and Chandler (6,211,527) as applied to claims 6-10 above, and further in view of Li et al 96,194,720).

Modified Allen et al discussed above in the paragraph 7 but do not teach the ion beam having a current energy in the range of about 500 to 3000 pico Amps.

However, in a milling process using focused ion beam, Li et al teach that the beam current comprises an energy from about 2500-3000 pico Amps for providing a

higher intensity of ion beams which are capable of removing more material in a shorter time period (col.7, lines 10-20).

Therefore, it would have been obvious to one skilled in the art at the time of claimed invention to combine Li et al's teaching into modified Allen et al's process in order to efficiently removing the reaction product by reducing the process time as taught by Li et al.

Allowable Subject Matter

9. Claims 4 and 11 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

10. The following is a statement of reasons for the indication of allowable subject matter: The prior art does not teach a method, wherein the unreacted halogen gas is removed by applying an electron beam as the context of claims 4 and 11.

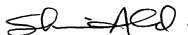
Conclusion

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Russel et al (US 2002/0094694) disclose a process, wherein Focused ion beam is directed to remove copper; Cecere et al (5,840,630) disclose a FIB etching of conductor layer by adding a halogen-containing gas to enhance the etching rate.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shamim Ahmed whose telephone number is (703) 305-1929. The examiner can normally be reached on M-Thu (7:00-5:30) Every Friday Off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on (703) 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are (703)-872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.



Shamim Ahmed
Patent Examiner
Art Unit 1765

SA
November 19, 2002